(12) UK Patent Application (19) GB (11) 2 123 621 A

(21) Application No 8318520
(22) Date of filing 8 Jul 1983
(30) Priority data
(31) 8220045
(32) 9 Jul 1982
(33) United Kingdom (GB)
(43) Application published
1 Feb 1984
(51) INT CL³
H01R 9/09 4/34 11/09
H05K 1/14
(52) Domestic classification
H2E 111 CE EKH
(56) Documents cited
GB 0378187
(58) Field of search
H2E
(71) Applicant
Unilab Limited,
(United Kingdom),
Clarendon Road,
Blackburn,
Lancashire
(72) Inventor
Cyril George Clark
(74) Agent and/or address for service
Appleyard Lees and Co.,
15 Clare Road,
Halifax,
HX1 2HY,
West Yorkshire

# (54) Connector for joining printed circuit boards

(57) The underside of the board (19) includes a printed circuit including a conductive path around a number of recesses (17, 18, 20, 21) in the edge of the board. The recesses of the board are located around one of a number of threaded bolts comprising part of the connector (1). Another board is brought in from the other side of the connector and the nuts (7) are tightened on the threaded bolts to hold the boards in place. A threaded washer electrically connects the conductive paths of the boards on either side of the connector. The central bolt (3) is slidably mounted within a slot (16) of the body (2) of the connector (1) and may engage either of a pair of recesses (20 or 21). A projection (22) moulded into the connector body (2) aligns with a non-electrical connecting edge recess (23) to prevent or allow, as required, boards (19) to be connected to one or both sides of the connector.

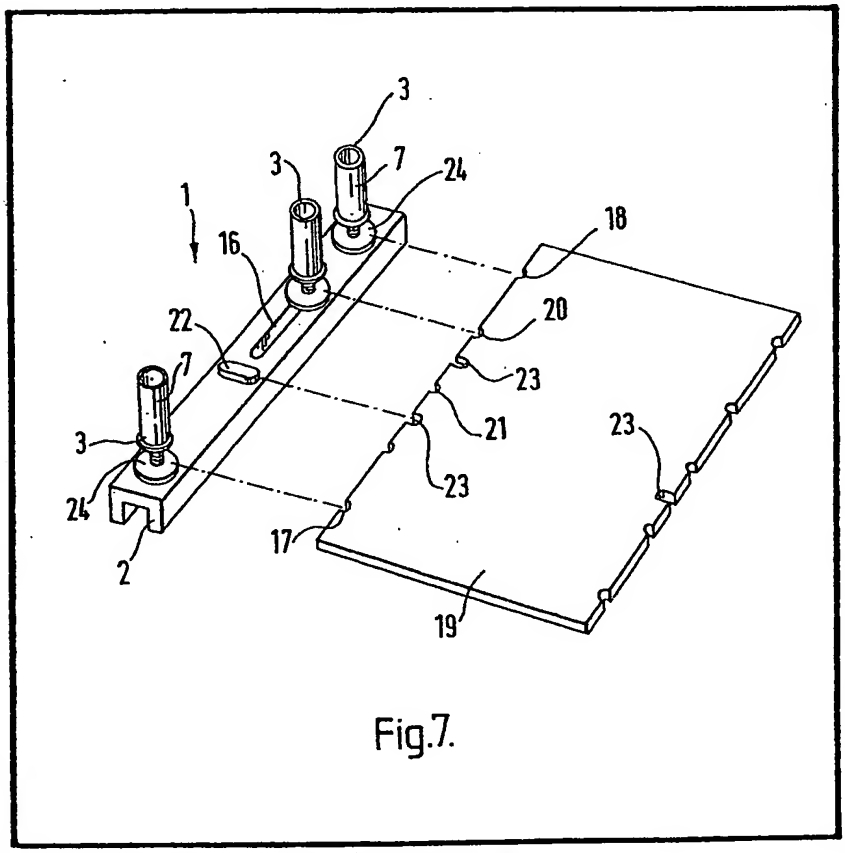



Fig.7.

GB 2 123 621 A

The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

Fig.3.

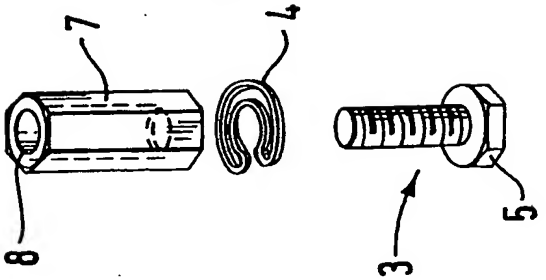



Fig.2.

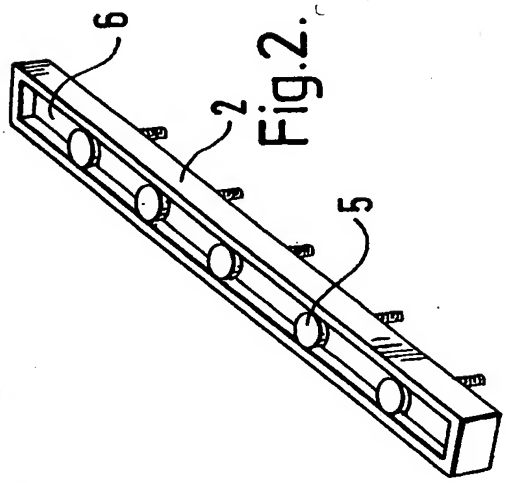



Fig.1.

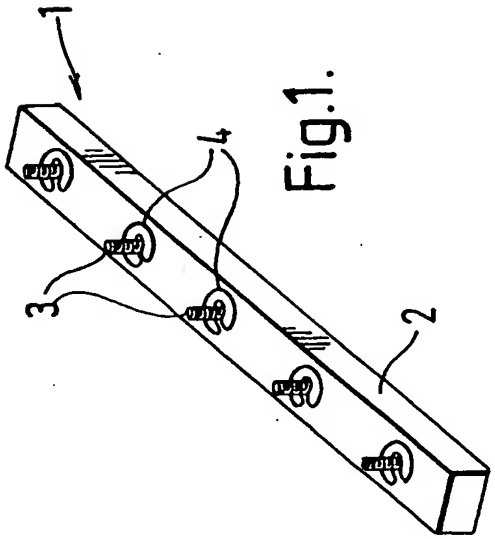
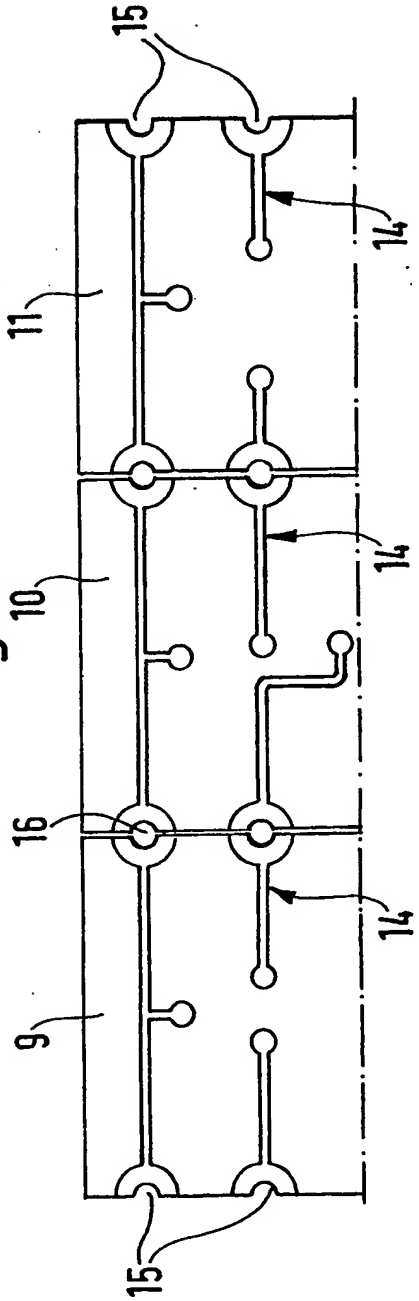



Fig.6.



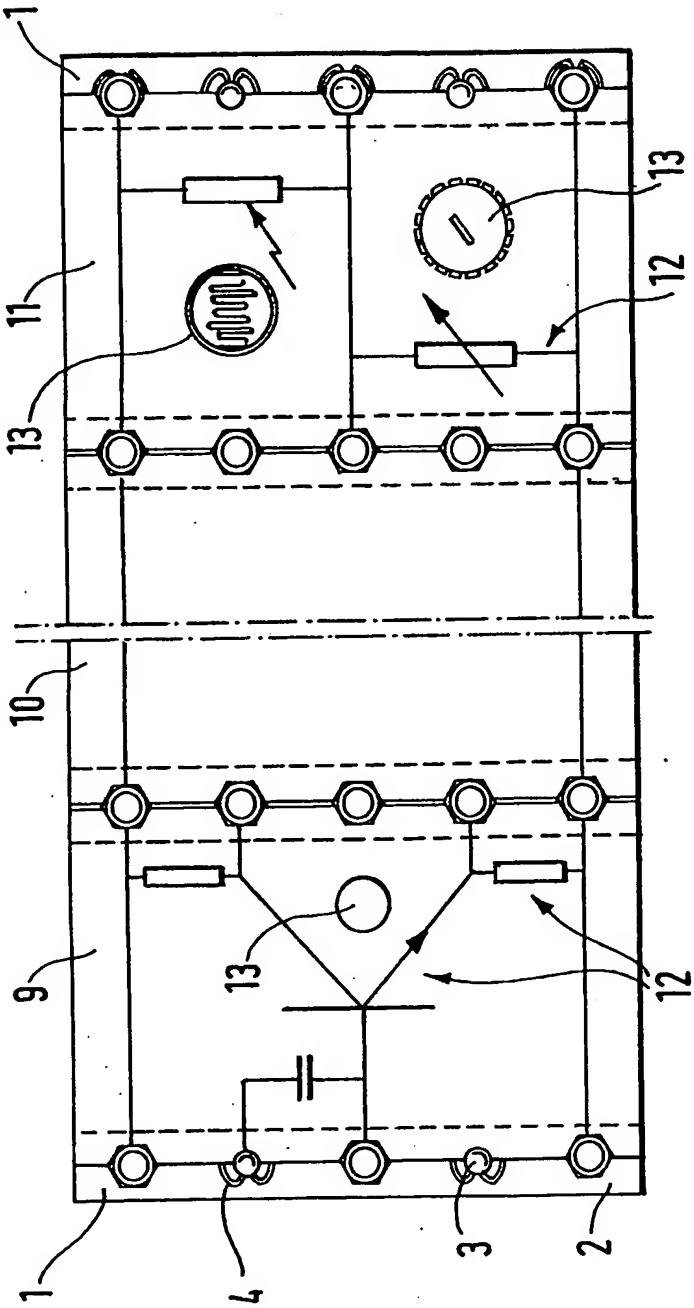



Fig.4.

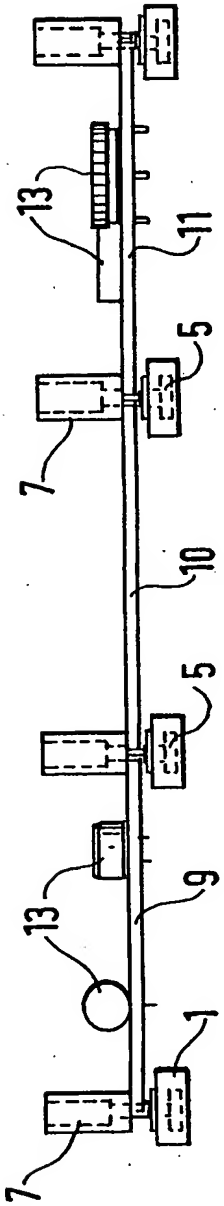



Fig.5.

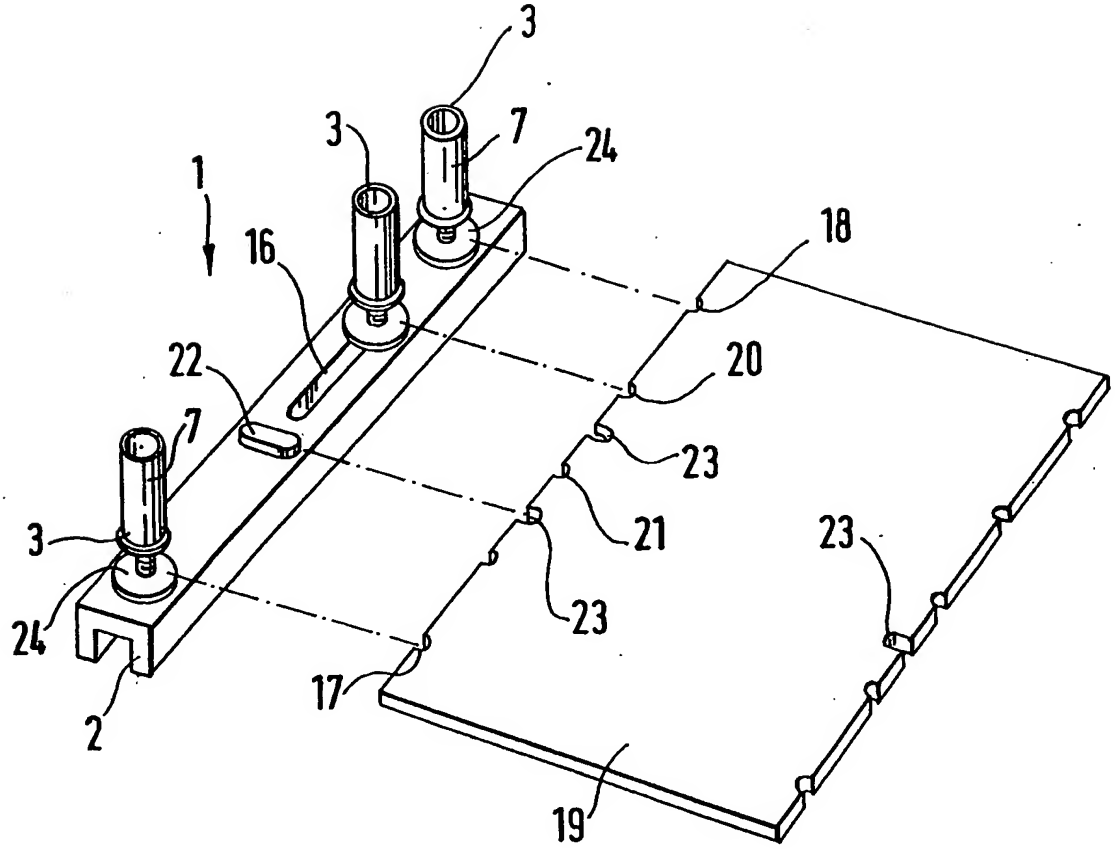



Fig.7.

SPECIFICATION

**Printed circuit boards and connectors therefor**

This invention relates to printed circuit boards and electrical connectors therefor. It is concerned particularly although not exclusively with educational circuit boards—i.e. boards which are used for teaching purposes.

Educational circuit boards have been popular for a number of years. Typically, they consist of a board which has predetermined locations for components, a circuit (usually of copper) printed on the underside, and a legend printed on the upper side. Circuits are made up by securing components in their predetermined locations, and making electrical connections to the boards and between boards, as necessary.

Much of the expense associated with educational circuit boards resides in the electrical connectors with which they have to be provided, for both external connections and connections between one board and the next. Preferred embodiments of the present invention aim to provide boards and connectors which may be improved in this respect.

More generally, according to a first aspect of the present invention, there is provided a printed circuit board which is formed along at least one edge with a series of recesses, the electrically conductive paths on the board extending adjacent to at least one of said recesses, and preferably around the recesses.

Preferably, the recesses are semi-circular, and are spaced at regular intervals.

The board may with advantage be formed with a respective series of recesses along each of two opposite edges, such that the recesses along one edge may be disposed adjacent corresponding recesses in an opposite edge of an adjacent similar circuit board.

The printed circuit board is preferably provided on its upper surface with legends which illustrate at least part of the circuit printed on the under surface of the board.

According to a second aspect of the present invention, there is provided an electrical connector for printed circuit boards, the connector comprising an elongate electrically insulative body, a series of studs projecting from the body, and a plurality of releasable fasteners engaging the studs, the arrangement being such that opposing edges of printed circuit boards may be clamped between said body and fasteners in such manner that the connector provides an electrical connection between the boards.

Preferably, the positions of the studs in the body are adjustable. The positions may be infinitely adjustable—for example, with the studs slidably mounted in the body. Alternatively, the body may be formed with a series of holes, through any one of which any one of the studs may project.

In one preferred embodiment, the body is provided with a series of holes at regular intervals, and each of the studs is in the form of a bolt which may project through any one of the holes. Each bolt is, preferably held in place in the body by means of a metal circlip, and the releasable fasteners comprise nuts which engage the bolts. The nuts and bolts may be electrically conductive, and the nuts may be elongate, being provided with sockets for receiving electrical plug connectors.

The provision of circlips to retain the bolts in the body may be particularly advantageous, in that the circlips serve to provide electrical connections between the opposing edges of the printed circuit boards. Where the bolts are electrically conductive, their heads are preferably recessed in the underside of the body, such that they are out of contact with the surface upon which the body is placed.

A printed circuit board in accordance with the first aspect of the invention is preferably provided in combination with an electrical connector in accordance with the second aspect of the invention, the spacing of the studs on the connector corresponding to the spacing of the recesses on the board.

It will be appreciated that the invention has particular application to educational circuit boards, when there may be provided a plurality of circuit boards in accordance with the first aspect of the invention and a plurality of connectors in accordance with the second aspect of the invention. Where the positions of the studs on the electrical connectors are adjustable, the connectors may be used to provide electrical connections as and when necessary between circuit boards, for circuit boards having different configurations of recesses.

The invention also extends to a method of making an electrical connection to a printed circuit board, comprising the steps of securing an electrical connector in accordance with the second aspect of the invention to at least one printed circuit board in accordance with the first aspect of the invention.

According to a further aspect of the present invention, an electrical connector comprises a row of releasable fasteners mounted on a base member, the fasteners being capable of occupying a released position in which two circuit boards may be brought in from different sides of the row so that a portion of both of the adjacent edges of the boards lie between the fasteners and the base member, and a clamped position in which each of the fasteners may engage a portion of the edges of both boards, and at least one of the fasteners may provide an electrical connection between the boards.

For a better understanding of the invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic drawings, in which:

Figure 1 is a perspective view of an electrical connector in accordance with the invention.

Figure 2 is a perspective view of one version of the connector, from below;

Figure 3 is an exploded view of a bolt, circlip and nut used in one version of the connector.

Figure 4 is a plan view of education circuit boards connected together by means of connectors such as that shown in Figures 1 to 3;

Figure 5 is a side view of the boards;

Figure 6 is a partial bottom plan view of the boards; and

Figure 7 is a perspective view of a further embodiment of an electrical connector and circuit board in accordance with the present invention.

The electrical connector 1, shown in Figures 1 to 3, comprises a body 2 of electrically insulative material (e.g. plastics), which is formed with a series of holes, at regular intervals. A respective bolt 3 passes through each of the holes, and is retained in position within the body 2 by means of a respective circlip 4. The head 5 of each bolt is located in a recess 6 formed in the lower part of the body 2. Thus, when the body 2 is placed on a surface, the heads 5 and the bolts 3 are maintained out of contact with that surface. The bolt heads 5 are hexagonal, and fit closely within the recess 6, to prevent rotation of the bolts 3.

A respective nut 7 is adapted to engage on each bolt 3. Each nut 7 is elongate, having an upper cylindrical socket 8, which is adapted to receive any suitable plug type connector (e.g. a banana plug). Each bolt 3, circlip 4 and nut 7 is metallic, such that it is electrically conductive.

Figures 4 and 5 show three circuit boards connected together by electrical connectors 1. The middle circuit board 10 is shown as discontinuous in Figure 4, to illustrate that any desired number of circuit boards may be similarly connected between the end boards 9 and 11.

The circuit boards 9, 10 and 11 are intended as educational circuit boards, to be assembled by students who are learning about electrical circuits. Thus, each of them has imprinted upon its upper surface a legend 12, illustrating by conventional electrical symbols the positions and interconnections between various components 13, which are to be secured in predetermined locations on the boards. The underside of each board 9, 10 and 11 is formed with a printed circuit 14 (for example, of tinned copper).

Each of the circuit boards 9, 10 and 11 is provided along each of two opposite edges with a series of five recesses 15, which are semi-circular in shape and spaced at regular intervals, corresponding to the spacing of the bolts 3 in the electrical connectors 1. The electrically conductive paths of the printed circuits extend around at least some of the recesses 15. (It is to be appreciated that Figure 6 is merely illustrative, and that the circuit pattern shown therein does not actually correspond to the circuit shown by way of example on Figure 4). In an alternative embodiment (not shown) three or four recesses may be provided.

In use, the various components 13 are soldered to the circuit boards 9, 10 and 11. The circuit boards are then disposed adjacent one another in the correct sequence, with their respective recesses 15 in alignment to define substantially circular holes 16 between each two adjacent boards. The connectors 1 are then engaged with the respective bolts 3 passing through the holes 16, and engaging the semi-circular recesses 15 along the free edges of the end panels 9 and 11. The nuts 7 are then tightened down to clamp each connector 1 firmly to its respective board(s). In Figure 4, some of the nuts 7 are omitted, such that the circlips 4 may be seen. It will be appreciated that each circlip 4 establishes electrical contact with the conductive path (where provided) around the respective recess 15 of each circuit board. Thus, where two boards are connected together, the respective connector 1 serves not only to provide the necessary mechanical connection, but also the necessary electrical connections between the boards, where desired.

It is to be appreciated that not all of the bolts 3 need be used in each connector 1, in every case. Thus, for example, electrical connections need to be made only at four of the five recesses 15 shown on the left hand edge of the circuit board 9 in Figure 4, and only three electrical connections need to be made along the right hand edge of the circuit board 11. Thus, where electrical connections are redundant, the corresponding nuts 3 may be omitted from the connectors 1, if desired, together with their respective circlips 4 and nuts 7. External connections to the circuit made up from the boards 9, 10 and 11 may readily be made *via* suitable plug connectors engaging within the sockets 8 provided in the nuts 7.

As the bolts 3 are removable from the connectors 1, it may be appreciated that the recesses 15 in the circuit boards need not be regularly spaced, although they are preferably provided at integral multiples of a unit spacing. A particularly important advantage of the illustrated system is that the connectors 1 are not provided integrally on the circuit boards 9, 10 and 11. Thus, in contrast to conventional educational circuit boards, the illustrated boards 9, 10 and 11 may be provided much more cheaply. Indeed, a user may simply keep a supply of standard connectors 1, which may be used and adapted as required for various configurations of circuit boards. The body 2 of each connector 1 may be cut to length from a continuous strip of material, such that a connector 1 of any desired length may be provided. The bolts 3 are then simply located in place at their desired locations. Alternatively, the bodies 2 are individually moulded from plastics.

As an alternative to the illustrated arrangement, the bolts 3 may be slidably mounted within suitable electrically insulative bodies, such that their positions may be infinitely adjustable. For example, as shown in Figure 7, one of the bolts 3 is shown slidably mounted within a slot 16 formed in the body 2. The recesses 17 and 18 formed towards either end of the circuit board 19, on the edge shown nearest

the body, can engage the bolts 3 at either end of the body. The slidably mounted bolt 3 can engage the recess 20 of the board, when the bolt is in the position shown, or alternatively the bolt can be moved along the slot 16 to a position in which it will engage with the recess 21. Alternatively, an additional bolt can be inserted into the slot in order that both of the recesses 20 and 21 can be engaged by bolts, or all bolts can be removed from the slot so that neither of the recess 20 or 21 are engaged.

The upwardly facing surface of the body 2 is provided with a projection 22 which is integrally moulded with the body. The projection 22 is arranged to extend into a channel 23 formed in the edge of the circuit board 19. The projection accurately aligns the circuit board on the body. Furthermore, as the projection extends more than the bolts 3 into the board, it ensures that the board can only be connected to the body when the projection lies in a channel 23 and the board is correctly located on the body. The projection 22 is located away from the centre of the body so that two channels 23 are required on one edge of the board if that edge of the board can be connected to the body from either side of the body. The other edge of the board 19 is only provided with a single channel 23 to ensure that that edge can only be connected to a body from one side of the body.

Instead of the bolts being retained on the body by a circlip, as they are in Figure 1, the bolts in Figure 7 are retained by a threaded washer 24 engaging the threaded shank of the bolt.

The sliding bolt 3 may not always be desirable in a teaching application, and regular unit spacing of the bolts may be preferred.

Instead of providing metal bolts 3 and nuts 7, electrically insulative bolts and nuts (e.g. of plastics) may be provided, for use in at least some positions. For example, where it is desired to provide a mechanical connection between two circuit boards, but to ensure as far as possible that no electrical connection is provided at that point, an insulating nut and bolt may be provided, with either an insulating circlip, or no circlip at all. A metal circlip may be used with an insulating bolt and nut, to provide an electrical connection between adjacent boards, with no external connection point. In such an arrangement, it may be desired to use metal bolts 3 and nuts 7 only where an external connection is required.

Instead of being provided with bolts 3, the electrical connectors 1 may be provided with any other suitable studs for engagement with the recesses 15, and the studs in turn may be provided with any other suitable releasable fasteners, for clamping the circuit boards between the fasteners and the bodies 2 of the connectors 1.

Printed circuit boards may be provided in various different shapes, as alternatives to the oblong boards 9, 10, 11 and 19 illustrated. For example, the boards may be square or hexagonal.

Any other suitable retaining clip, preferably electrically conductive, may be provided as an alternative to the metal circlips 4, for instance the threaded washer shown in Figure 7.

**Claims**

1. An electrical connector for printed circuit boards, the connector comprising an elongate electrically insulative body, a series of studs projecting from the body, and a plurality of releasable fasteners engaging the studs, the arrangement being such that opposing edges of printing circuit boards may be clamped between the body and the fasteners in such a manner that the connector provides an electrical connection between the boards.

2. A connector as claimed in Claim 1 in which the position of at least one of the studs in the body is adjustable.

3. A connector as claimed in Claim 2 in which at least one of the studs is slidably mounted in the body.

4. A connector as claimed in Claim 3 in which the body includes an elongate slot in which one or more studs may be mounted.

5. A connector as claimed in any preceding claim in which the body includes a series of holes through any one of which one of the studs may project.

6. A connector as claimed in any preceding claim in which at least one of the studs comprises a bolt.

7. A connector as claimed in Claim 6 in which the or each bolt is held in place on the body by means of a circlip.

8. A connector as claimed in Claim 6 in which the or each bolt is held in place on the body by means of a threaded washer.

9. A connector as claimed in Claim 7 or Claim 8 in which the circlip or washer are of electrically conductive material which may serve to provide an electrical connection between two circuit boards.

10. A connector as claimed in Claim 6, 7 or 8 in which the circlip or threaded washer, in use, engages with an electrical conductive path of a board or boards.

11. A connector as claimed in Claim 6, 7, 8, 9 or 10 in which the body is channel shaped in cross-section and the head of the bolt or bolts is located between opposed portions of the channel shaped member, and restrained from rotating relative to the body by the head engaging the opposed portions of the channel shaped member.

12. A connector as claimed in any of Claims 6 to 11 in which the releasable fastener comprises a threaded nut.

13. A connector as claimed in Claim 12 in which the threaded nut includes a portion extending clear of the bolt and providing an electrical socket.

14. A connector as claimed in any preceding claim in which the body includes a projecting lug arranged to co-operate with circuit boards being connected by the connector.

15. A connector as claimed in any preceding

claim in which the electrically insulative body is moulded from plastics.

16. An electrical connector comprising a row of releasable fasteners mounted on a base member, the fasteners being capable of occupying a released position in which two circuit boards may be brought in from different sides of the row so that a portion of both of the adjacent edges of the boards lie between the fasteners and the base member, and a clamped position in which each of the fasteners may engage a portion of the edges of both boards, and at least one of the fasteners may provide an electrical connection between the boards.

17. A printed circuit board, at least one edge of which has a series of recesses, and an electrically conductive path on the board extending adjacent to at least one of the recesses.

18. A printed circuit board as claimed in Claim 17 in which the electrically conductive path extends around at least a portion of the recess.

19. A printed circuit board as claimed in Claim 17 or 18 in which the recesses are spaced at regular intervals.

20. A printed circuit board as claimed in Claim 17, 18 or 19 in which opposed edges of the board each have a series of recesses.

21. A printed circuit board as claimed in any of Claims 17 to 18 in which at least one edge of which includes at least one channel located away from the centre of that edge.

22. At least two electrically connected printed circuit boards as claimed in any of Claims 17 to 21 which are connected by an electrical connector as claimed in any of Claims 1 to 16.

23. An electrical connector substantially as herein specifically described with reference to, and as shown in any of Figures 1 to 5 or Figure 7 of the accompanying drawings.

24. A printed circuit board substantially as herein specifically described with reference to, and as shown in any of Figures 4, 5, 6 or 7.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1984. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.